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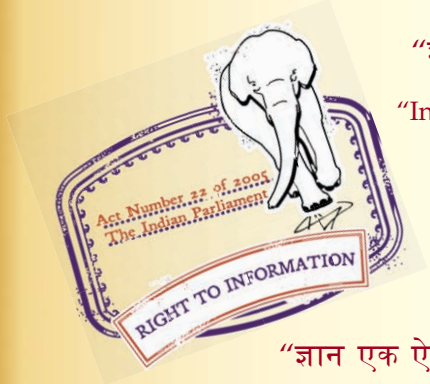


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"Knowledge is such a treasure which cannot be stolen"

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# *Indian Standard*

# GUIDE FOR ESTIMATING COST OF FARM MACHINERY OPERATION

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# GUIDE FOR ESTIMATING COST OF FARM MACHINERY OPERATION

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# *Indian Standard*

# GUIDE FOR ESTIMATING COST OF FARM MACHINERY OPERATION

## 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 28 May 1979, after the draft finalized by the Agricultural Tractors and Power Tillers Sectional Committee had been approved by the Agricultural and Food Products Division Council.

**0.2** With the increasing use of farm machinery for providing custom hiring services in the country, estimation of cost of operation by using a uniform method, has assumed considerable significance. The custom services are being organized so that every farmer can reap the advantages of mechanized farming practices, since it is practically neither possible for every farmer to own all farm machinery nor it would be economically viable. Moreover, by way of operating farm machinery on more than one farm, capital outlay and running cost can also be reduced considerably. Such services are being organized by individual farmers, commercial enterprises, agro-industries corporations, agro-service centres, etc.

**0.3** The object of estimating cost of farm machinery operation is to serve as a basis for planning and management. Thus for a contractor, the main object may be to create a basis for establishing rates and for checking them from time to time. For this purpose, results from cost calculation can be used firstly to compare the income received from a job with the cost of its performance and to suitably adjust the rates; and secondly to pin-point unreasonably high cost and the reasons for them so that timely action can be taken to reduce them. For a farmer, the main purpose of calculating cost may be to compare, for example, the cost of having his own machine with the cost of employing a contractor, or costs of different types or sizes of machines. It will also help to check the cost of production of a particular crop to ensure its profitability. In view of the above a need was, therefore, felt, to prepare guidelines for estimating cost in a rational way.

**0.4** In the preparation of this standard, assistance has been taken from various agro-industries corporations and different organizations using fleets

of farm machinery for hiring purposes. Assistance has also been taken from the following:

Multifarm use of agricultural machinery. Food and Agriculture Organizations of United Nations, Rome.

ASAE D — 230.2 Agricultural machinery management data. American Society of Agricultural Engineers. USA.

**0.5** The Committee, while finalizing this standard, discussed in detail the present limitations in stipulating various norms for calculation of cost of farm machinery operation, since the indigenous information on most of the items are not available in a consolidated manner. It however, felt the need for bringing out this standard based on the present knowledge and experience in the field. The Committee also recommended that various agricultural universities and Indian Council of Agricultural Research ( ICAR ) should compile the information on various components coming in the way of cost of farm machinery operation and the data thus obtained would help the committee in amending the standard at a later stage on sound basis.

**0.6** While finalizing this standard, the Committee felt that the useful life of some of the farm machinery given in the standard should be used only for the purpose of estimating the cost of farm machinery operation which is normally done before the operation starts. The stipulated life should not be used as a criteria for declaring the farm machinery obsolete by users.

**0.7** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## 1. SCOPE

**1.1** This standard recommends guidelines for estimating cost of farm machinery operation.

## 2. COST FACTORS

**2.1** The cost of using farm machinery consists of expenses for ownership and operation, and overhead charges. It may also include a margin for profit. Ownership costs are independent of use and are often called as

*Rules for rounding off numerical values ( *revised* ).

fixed costs. Costs for operation vary directly with use and are referred to as variable costs. A summary of cost items is given below:

a) Fixed Costs:

1) Depreciation;
2) Interest on investment;
3) Insurance and taxes ( property, registration and road ); and
4) Housing.

b) Variable Costs:

1) Fuel,
2) Lubricating oil,
3) Repair and maintenance, and
4) Wages and labour charges.

c) Overheads

## 3. FIXED COSTS

**3.1 Depreciation** — This cost reflects the reduction in value of a machine with use ( wear ) and time ( obsolescence ). While actual depreciation would depend on the sale price of the machine after its use, on the basis of different computational methods depreciation can be estimated. The following formula based on straight-line method is recommended:

$$D = \frac{P - S}{L}$$

where

$D$ = depreciation cost, average per year;
$P$ = purchase price of the machine;
$S$ = residual value of the machine ( *see* **3.1.1** ); and
$L$ = useful life of the machine in years ( *see* **3.1.2** ).

NOTE — The depreciation cost per hour can be calculated by dividing $D$ by the number of hours the machine is expected to be utilized in a year.

**3.1.1** Residual value of the machines may be taken as 5 percent of the purchase price.

**3.1.2** Useful life of some of the commonly used machines under general conditions of usage is given in Table 1 for guidance.

**TABLE 1 USEFUL LIFE OF SOME OF THE COMMONLY USED FARM MACHINERY**

( *Clause* 3.1.2 )

| Sl No. | Name of Machine | Useful Life | |
|---|---|---|---|
| | | Hours | Years |
| (1) | (2) | (3) | (4) |
| i) | Stationary engine | 10 000 | 10 |
| ii) | Electric motor | 15 000 | 15 |
| iii) | Power tiller | 8 000 | 10 |
| iv) | Tractor ( wheeled and crawler ) | 10 000 | 10 |
| v) | Combine ( self-propelled ) | 3 000 | 6 |
| vi) | Combine ( mounted and drawn ) | 2 000 | 7 |
| vii) | Seed drill | 2 500 | 10 |
| viii) | Seed-cum-fertilizer drill | 2 000 | 8 |
| ix) | Planter | 2 000 | 10 |
| x) | Plough | 3 000 | 10 |
| xi) | Disc harrow | 3 000 | 10 |
| xii) | Cultivator | 4 000 | 10 |
| xiii) | Front-mounted dozer attachment for wheeled tractor | 3 000 | 10 |
| xiv) | Towed scraper for wheeled tractor | 2 000 | 10 |
| xv) | Power sprayer ( knapsack and tractor mounted ) | 2 000 | 8 |
| xvi) | Seed cleaner | 2 500 | 5 |
| xvii) | Agricultural trailer | 3 600 | 12 |
| xviii) | Power thresher | 2 500 | 8 |
| xix) | Centrifugal pump | 10 000 | 10 |
| xx) | Power chaff cutter | 5 000 | 8 |
| xxi) | Rotavator | 2 400 | 8 |
| xxii) | Ridger | 1 500 | 12 |
| xxiii) | Blade terracer | 2 000 | 10 |
| xxiv) | Puddler | 2 500 | 10 |
| xxv) | Cane crusher | 10 000 | 10 |

**3.2 Interest** — Annual charges of interest should be calculated on the basis of the actual rate of interest payable. If this information is not available, 12 percent of average purchase price should be taken. Average

purchase price shall be calculated by the following formula:

$$A = \frac{P + S}{2}$$

where

$A$ = average purchase price,
$P$ = purchase price of the machine, and
$S$ = residual value of the machine.

**3.3 Insurance and Taxes** — Actual amount paid or to be paid annually for insurance and annual taxes, if any should be charged. If the information is not available, it may be calculated on the basis of 2 percent of the average purchase price ( *see* $A$ in **3.2** ) of the machine.

**3.4 Housing** — It should be calculated on the basis of 1·5 percent of the average purchase price ( *see* $A$ in **3.2** ) of the machine.

## 4. VARIABLE COSTS

**4.1 Fuel** — Fuel consumption depends on the size of the power unit, load factor and operating conditions. The actual consumption can be observed while the machine is working or may be taken from the results obtained at official testing stations. It is common practice to consider average fuel consumption from the varying load test [ *see* **4.5** of IS : 5994 ( Part II )-1979* ] as approximately equal to fuel consumption on the farm. Average fuel consumption can also be estimated by the following formulae:

a) $A = 0{\cdot}15 \times B$

where

$A$ = average diesel consumption in l/h,
$B$ = rated power in kW.

b) $C = 0{\cdot}25 \times B$

where

$C$ = average petrol consumption in l/h,
$B$ = rated power in kW.

**4.2 Oil** — The actual oil consumption should be recorded while the machine is working. In case oil consumption data is not available, oil

*Test code for agricultural tractors: Part II Laboratory and track tests (*first revision*).

consumption may be taken as 2·5 to 3 percent of the fuel consumption on volume basis. The cost of filters, replacement of oil and other lubricants is included under repairs and maintenance ( *see* **4.3** ).

**4.3 Repair and Maintenance** — Repair and maintenance expenditures are necessary to keep a machine operable due to wear, part failure renewal of tyres and tubes and accidents. The costs of restoring a machine are highly variable. Good machinery management may keep cost low. Normal wear deterioration is directly related to use, and restoration or repair costs are assumed to be typical variable costs. Maintenance costs, primarily those related to lubrication, are directly related to use also.

**4.3.1** The accumulated repair and maintenance costs ( TAR ) at any point in a machine's life can be estimated from the following formulae:

a) For four-wheeled and crawler tractors — $TAR = 0{\cdot}100X^{1{\cdot}5}$

b) For stationary power unit and two-wheeled tractor — $TAR = 0{\cdot}120X^{1{\cdot}5}$

c) For self-propelled combine, dozer and scraper — $TAR = 0{\cdot}096X^{1{\cdot}4}$

d) For agricultural trailer — $TAR = 0{\cdot}127X^{1{\cdot}4}$

e) For pto-driven combine, seed drill, seed-cum-fertilizer drill and sprayer — $TAR = 0{\cdot}159X^{1{\cdot}4}$

f) For seed cleaner — $TAR = 0{\cdot}191X^{1{\cdot}4}$

g) For plough, planter, harrow, ridger and cultivator — $TAR = 0{\cdot}301X^{1{\cdot}3}$.

**4.3.2** The repair cost in percentage of purchased price for whole usable life ( *see* Table 1 ) of some of the machines calculated on the basis of formulae given in **4.3.1** is given in Table 2 for guidance.

**4.4 Wages and Labour Charges** — In performing custom work, the cost of at least one operator has to be included. Sometimes an assistant may also be engaged. One or both of them may be employed on a yearly basis, and the yearly cost of the operators is equal to the wages paid plus any allowances to which they may be entitled. Average cost per hour may be computed by dividing the total cost by the number of hours the operator has performed the work. This cost is, of course, higher than the average per hour work on the farm because part of the time will be used for travelling, interruptions and moving machines from one farm to another, and this is not paid for directly by the customers.

**TABLE 2 PERCENTAGE OF ACCUMULATED REPAIR COST**

( *Clause* 4.3.2 )

| Sl No. | Name of Machine | Cost in Percentage of Purchase Price for Usable Life in Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
| i) | Stationary engine | 3·8 | 10·8 | 19·8 | 30·3 | 42 | 55·5 | 70·3 | 86·4 | 102·6 | 120 | — | — | — | — | — |
| ii) | Electric motor | 2 | 5·8 | 10·7 | 16·5 | 23 | 30·1 | 38·4 | 46·7 | 56·1 | 65·3 | 75·2 | 84·9 | 96·8 | 108·1 | 120 |
| iii) | Power tiller | 3·8 | 10·8 | 19 8 | 30·3 | 42 | 55·5 | 70·3 | 86·4 | 102·6 | 120 | — | — | — | — | — |
| iv) | Tractor ( wheeled & crawler ) | 3·2 | 9·0 | 16·5 | 25·3 | 35 | 46·2 | 58·6 | 72 | 85·5 | 100 | — | — | — | — | — |
| v) | Combine ( self propelled ) | 4·9 | 13 | 23 | 34·3 | 46·8 | 60·6 | — | — | — | — | — | — | — | — | — |
| vi) | Combine ( mounted & drawn ) | 6·6 | 17·3 | 30·4 | 44·8 | 61·9 | 80 | 100·3 | — | — | — | — | — | — | — | — |
| vii) | Seed drill | 4 | 10·5 | 18·6 | 27 | 38·9 | 49 | 60·9 | 73·4 | 86·5 | 100·3 | — | — | — | — | — |
| viii) | Seed-cum-fertilizer drill | 5·5 | 14·4 | 25·4 | 38 | 52·5 | 67 | 83·2 | 100·3 | — | — | — | — | — | — | — |
| ix) | Planter | 6 | 14·8 | 29 | 36·4 | 48·7 | 61·6 | 75·4 | 88·7 | 104·4 | 119·8 | — | — | — | — | — |
| x) | Plough | 6 | 14·8 | 29 | 36·4 | 48·7 | 61·6 | 75·4 | 88·7 | 104·4 | 119·8 | — | — | — | — | — |
| xi) | Disc harrow | 6 | 14·8 | 29 | 36·4 | 48·7 | 61·6 | 75·4 | 88·7 | 104·4 | 119·8 | — | — | — | — | — |
| xii) | Cultivator | 6 | 14·8 | 29 | 36·4 | 48·7 | 61.6 | 75·4 | 88·7 | 104·4 | 119·8 | — | — | — | — | — |
| xiii) | Dozer | 2·4 | 6·4 | 11·2 | 16·9 | 22·9 | 29·6 | 36·8 | 44·3 | 52·3 | 60·6 | — | — | — | — | — |
| xiv) | Scraper | 2·4 | 6·4 | 11·2 | 16·9 | 22·9 | 29·6 | 36·8 | 44·3 | 52·3 | 60·6 | — | — | — | — | — |
| xv) | Power sprayer | 5·5 | 14·4 | 25·4 | 38 | 52·5 | 67 | 83·2 | 100·3 | — | — | — | — | — | — | — |
| xvi) | Seed cleaner | 12·6 | 33·2 | 58·9 | 87·3 | 120·5 | — | — | — | — | — | — | — | — | — | — |
| xvii) | Agricultural trailer | 2·5 | 6·5 | 11·5 | 17·2 | 23·8 | 30·4 | 37·7 | 45·4 | 53·6 | 63·4 | 70·9 | 80·1 | — | — | — |

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## 5. OVERHEAD CHARGES

**5.1** This includes charges for supervision and establishment and interest on working capital if applicable. It should be assumed as 20 percent of the sum of fixed and variable costs.

## 6. TOTAL COST PER HOUR

**6.1** The sum of fixed cost, variable cost and overheads per hour shall give the total cost.

## 7. TOTAL COST PER HECTARE

**7.1** The total cost per hectare may be obtained on the basis of field capacity of the machine. The data regarding kind of machine, its working width, average speed of travel, size and shape of the fields and travel conditions should be recorded by the contractor since this kind of data would be very useful and would be sufficiently accurate. However, if no such data is available, the estimation of field capacity should be made by calculation on the basis of the following formula:

$$C = \frac{S\,W}{10} \times \frac{E}{100}$$

where

$C$ = effective field capacity in hectare per hour,

$S$ = speed of travel in km per hour,

$W$ = theoretical width of the machine in m, and

$E$ = field efficiency in percent at theoretical field capacity.

**7.2 Field Efficiency** — Field efficiency is a measure of relative productivity of a machine under field conditions. It accounts for failure to utilize the theoretical operating width of the machine, operator's capability and habits, operating policy and field characteristics. The activities, such as turning and idle travel, materials ( seed, fertilizer, chemicals, water, harvested material, etc ) handling, cleaning clogged equipment, machine adjustment, lubrication and refuelling and waiting for other machines accounts for a majority of the time lost in the field. Travel to or from a field, major repairs, preventive maintenance and daily service activities are not included in field time or field efficiency.

**7.2.1** Field efficiency is not a constant for a particular machine, but varies with the type of soil, size and shape of the field, pattern of field operation, crop yield, moisture and crop conditions. In absence of any data the field efficiency shall be selected from Table 3. Recommended speed of travel is also given in Table 3.

**TABLE 3 TYPICAL RANGES OF RECOMMENDED SPEED AND FIELD EFFICIENCIES FOR VARIOUS MACHINES**

( *Clause* 7.2.1 )

| Sl No. | Machine | Recommended Average Speed of Travel | Recommended Average Field Efficiency |
|---|---|---|---|
| (i) | (2) | (3) | (4) |
| | | km/h | percent |
| i) | Plough | 4·5 | 80 |
| ii) | Disc harrow | 6 | 80 |
| iii) | Cultivator | 6 | 80 |
| iv) | Seed drill | 5 | 70 |
| v) | Seed-cum-fertilizer drill | 5 | 70 |
| vi) | Planter | 5 | 70 |
| vii) | Ridger | 4·5 | 90 |
| viii) | Puddler | 5 | 75 |
| ix) | Rotavator | 2·5 | 80 |
| x) | Combine ( self-propelled ) | | |
| | — for paddy | 2 | 75 |
| | — for wheat | 3·5 | 75 |
| xi) | Combine ( mounted and drawn ) | | |
| | — for paddy | 2 | 70 |
| | — for wheat | 3 | 70 |

AMENDMENT NO. 1 APRIL 1982

TO

# IS:9164-1979 GUIDE FOR ESTIMATING COST OF FARM MACHINERY OPERATION

## Addendum

[*Page 8, clause 4.3.1*(g)] - Add the following new matter at the end of the clause:

'where

TAR = Total Accummulated Repair Cost divided by purchased price of the machine expressed as percentage, and

*X* = 100 times the ratio of the accummulated hours of use to the wear out life given in Table 1.'

(AFDC 52)

Reprography Unit, ISI, New Delhi, India